Source eNodeB Interfaces (Successful Handover)				
LTE Mobile	eNodeB Network		Core Network	**EventStudio System Designer 6**
UE	Target eNodeB	Source eNodeB	SGW	20-Apr-13 22:03 (Page 1)

This sequence diagram was generated with EventStudio Sytem Designer - http://www.EventHelix.com/EventStudio/

eNodeBs in LTE are interconnected with the X2 interface. If two eNodeBs are served by the same MME, handover from the source to the target eNodeB will take place over the X2 interface.

Before the handover
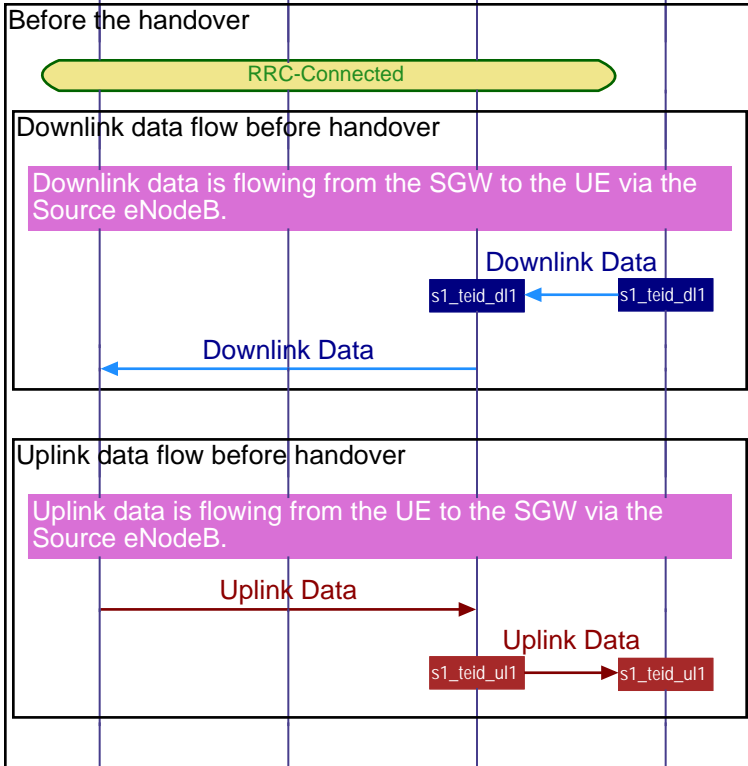
RRC-Connected

The UE and Source eNodeB are in RRC Connected state.

Downlink data flow before handover

Downlink data is flowing from the SGW to the UE via the Source eNodeB.

Downlink Data

s1_teid_dl1 ← s1_teid_dl1

Downlink Data

Uplink data flow before handover

Uplink data is flowing from the UE to the SGW via the Source eNodeB.

Uplink Data

Uplink Data

s1_teid_ul1 → s1_teid_ul1

Handover preparation

RRC Measurement Control

rrc ← rrc
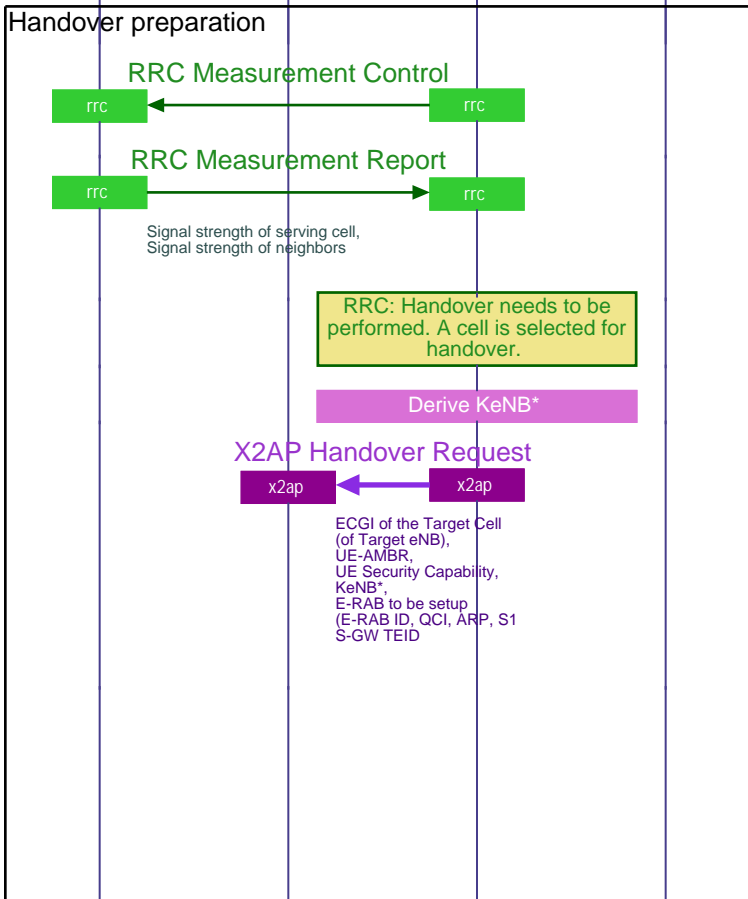
The network sets the measurement thresholds for sending measurement reports.

RRC Measurement Report

rrc → rrc

Neighboring cell signal quality is now better than the serving cell.

Signal strength of serving cell,
Signal strength of neighbors

RRC: Handover needs to be performed. A cell is selected for handover.

The RRC uses the latest measurement to decide if a handover is needed to another cell. The target cell is selected. The eNodeB for the target cell is identified.

Derive KeNB*

X2AP Handover Request

x2ap ← x2ap

The Source eNodeB initiates the handover with the Handover Request message. Information about active E-RABs, security keys is included in the message. (Click on the message name above the arrow to see message details)

ECGI of the Target Cell
(of Target eNB),
UE-AMBR,
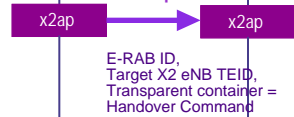UE Security Capability,
KeNB*,
E-RAB to be setup
(E-RAB ID, QCI, ARP, S1
S-GW TEID

Source eNodeB Interfaces (Successful Handover)

LTE Mobile	eNodeB Network		Core Network	EventStudio System Designer 6
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X2AP Handover Request Acknowledge

x2ap → x2ap

E-RAB ID,
Target X2 eNB TEID,
Transparent container =
Handover Command

The Target eNodeB responds back to the source eNodeB with a Handover Request Acknowledge message. This message carries the Handover Command message (RRC Connection Reconfiguration Request) in a transparent container. (Click on the message name above the arrow to see message details)
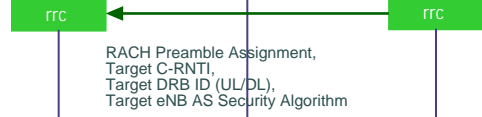
X2 Bearer Esablishment

x2_teid ↔ x2_teid

An X2 GTP connection is established between the Source and the Target eNodeBs. This channel will carry the user data during the handover.

## Handover execution

RRC Connection Reconfiguration Request

rrc ← rrc

RACH Preamble Assignment,
Target C-RNTI,
Target DRB ID (UL/DL),
Target eNB AS Security Algorithm

The Source eNodeB sends a handover command to the UE. The message contains a new C-RNTI and new DRB IDs. A RACH preamble is also included for contention free RACH access.

X2AP SN Transfer Status

x2ap ← x2ap

Downlink PDCP
Sequence Number,
Uplink PDCP Sequence
Number
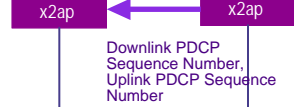
The PDCP sequence numbers are sent from the source to the target eNodeB. (Click on the message name above the arrow to see message details)

Downlink data flow during handover preparation

At this point all downlink data is getting rerouted from the source eNodeB to the target eNode. The data is being buffered at the target as the UE is yet to connect to the target.

Downlink Data

s1_teid_dl1 ← s1_teid_dl1

Downlink Data

x2_teid ← x2_teid
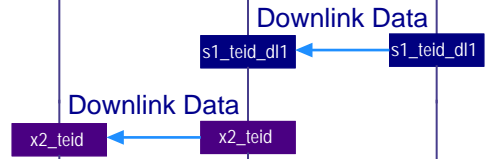
Uplink data flow during handover preparation

The uplink data is still being sent from the UE to the SGW via the Source eNodeB.

Uplink Data

Uplink Data

s1_teid_ul1 → s1_teid_ul1

RRC-Idle

At this point, the UE has detached from the source eNodeB but is still not communicating with the target eNodeB. The UE is in the RRC-Idle state.

The UE is now connected to the target eNodeB. All the queued messages are now transmitted towards the UE.
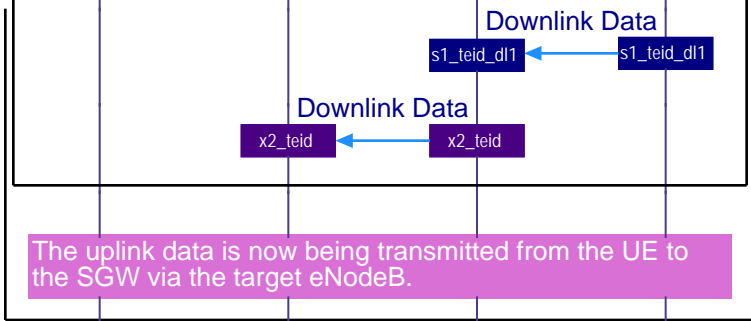
Downlink data flow during handover execution

During handover execution the data being routed from the SGW to the UE via the source and the target eNodeBs.
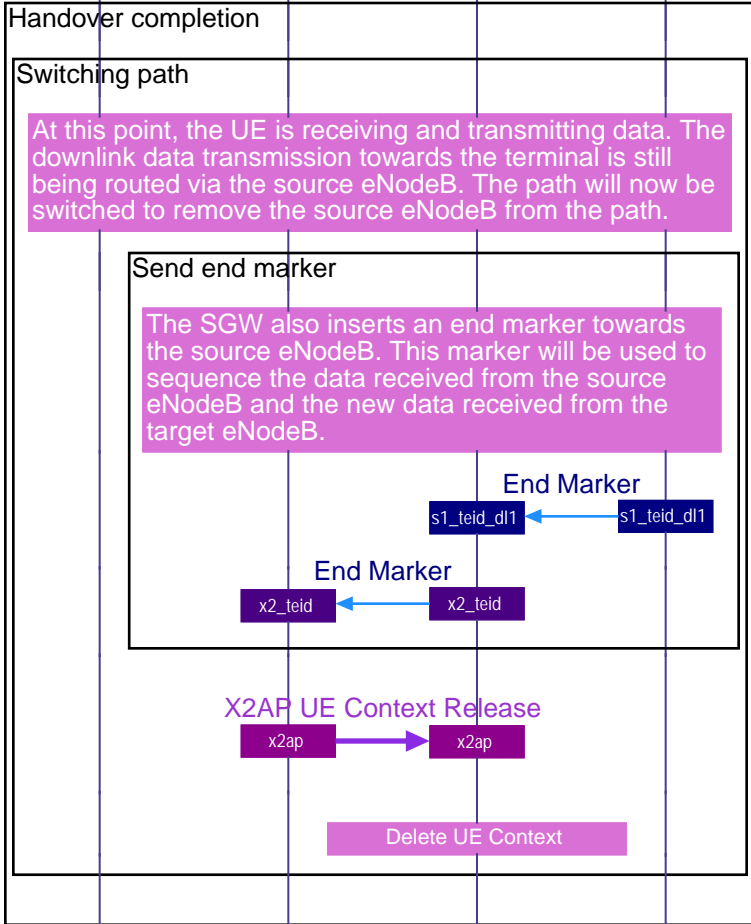
Source eNodeB Interfaces (Successful Handover)

LTE Mobile	eNodeB Network		Core Network	**EventStudio System Designer 6**
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Downlink Data

s1_teid_dl1 ← s1_teid_dl1

Downlink Data

x2_teid ← x2_teid

The uplink data is now being transmitted from the UE to the SGW via the target eNodeB.

Handover completion

Switching path

At this point, the UE is receiving and transmitting data. The downlink data transmission towards the terminal is still being routed via the source eNodeB. The path will now be switched to remove the source eNodeB from the path.

Send end marker

The SGW also inserts an end marker towards the source eNodeB. This marker will be used to sequence the data received from the source eNodeB and the new data received from the target eNodeB.

End Marker

s1_teid_dl1 ← s1_teid_dl1

End Marker

x2_teid ← x2_teid

X2AP UE Context Release

x2ap → x2ap

The end marker has been received at the Target eNodeB. At this point the target asks the source eNodeB to release resources for the UE. (Click on the message name above the arrow to see message details)

Delete UE Context